

As a preliminary matter -- no reference of record discloses optical methods of predicting imminent failure of gas sensors or structures that will achieve that purpose. The only references pertaining to optical detection of gas in a closed container relate to bubble detection. The references directed to optical bubble detection methods, as outlined in detail below, do not pertain to, or even mention electrochemical cells, nor do they teach, suggest or provide a motive for applying the bubble detection devices specifically to an electrochemical cell to detect expansion of a gas pocket in the electrochemical cell, in a portion of the interior volume of the cell in which gas collects before or during failure of the cell from loss of electrolyte from the interior volume, and thereby predict or anticipate failure of the electrochemical cell.

The Examiner has rejected claims 32-34, 36-39 and 41 under 35 U.S.C. §102(b) for anticipation by U.S. Patent No. 5,237,855 to Gates ("Gates"), claims 32-34, 36-39 and 41 for obviousness under 35 U.S.C. §103(a) over Gates and claim 35 for obviousness over Gates in view of Japan 59-54936. Specifically, the Examiner asserts that Gates discloses an optical means for detecting gas bubbles comprising a photoelectric sensor and a light source. Japan 59-54936 discloses a use of a laser in a bubble detector. The present claims require that the light beam passes through a portion of the interior volume of the gas detector where gas pockets form in the electrolyte during or prior to failure of the electrochemical cell for loss of electrolyte. The presently claimed invention is not a bubble detector, but a gas pocket detector. The difference is significant. Gates and Japan 59-54936 provide leak detection apparatuses that detect bubbles escaping from a leaking chamber. The chamber is not an electrochemical cell, and therefore neither Gates nor Japan 59-54936 extend, or can be extended, to a method and apparatus to detect and predict imminent failure of an electrochemical cell.

The present invention, as claimed, predicts imminent failure of an electrochemical cell. Unlike the devices disclosed in Gates and Japan 59-54936, it does not matter if there are leaks in the electrochemical cell (though leakage is not preferred), nor does the rate of leakage matter. What matters is that the gas pocket detector identifies the presence of a sufficient amount of gas in an electrochemical cell such that further collection of gas would be detrimental to the operation of the

electrochemical cell. That is not taught by Gates, or by any other reference of record in the present application. Japan 59-54936 does not depict an electrochemical cell, and, though it shows use of a laser to detect the bubbles leaking from a submerged, pressurized container (to test the integrity of the container), there is no reason to apply that reference to electrochemical cells. The claimed matter is novel and for the reasons set forth above, no *prima facie* case has been made that provides motive to use optical detection methods to predict failure of an electrochemical cell in the manner claimed.

Applicants have reviewed the claims and have removed any language that can be considered "functional." Applicants note that the current claim language requires that the apparatus is configured to pass a light beam along a defined path in an electrochemical cell, and a person of skill in the art can understand precisely, based on the language of the claims, where the light beam should pass and where the detector must be positioned (see below and *Manual of Patent Examining Procedure* ("MPEP"), Section 2173.05(g)). It would be completely evident where gas would collect in any given electrochemical cell and where electrolyte contact with the first of the two electrodes would first be lost. No prior art document of record, alone or in combination with another reference disclosed or suggests such a configuration. For that reason, applicants do not believe that the claims are described in, or are obvious over, the disclosure of Gates, alone or in combination with any other reference of record in the present application.

The Examiner has rejected claims 1, 5-14, and 18-41 under 35 U.S.C. § 103(a) for obviousness over U.S. Patent No. 3,410,778 ("Krasberg") in view of Gates or Japan 59-54936. Krasberg discloses the problem of bubble formation in oxygen sensors that undergo pressure variations, such as in SCUBA gear, and an extension of that disclosure arguably is that collection of gas in an electrochemical oxygen sensor affects the operability of the sensor. In Krasberg, there is no stated need for a method for detecting gas formation in the sensor and, therefore, no detection means is provided in that reference. Krasberg provides a method for preventing gas bubble formation in an oxygen sensor. As discussed above, Gates and Japan 59-54936 disclose bubble detection methods that have no stated or inferred use in electrochemical cell technology. The Examiner has not made a *prima facie* case of obviousness because

none of the references cited in this rejection provide the motivation to detect gas pocket formation in an electrochemical cell using optical means, or even that it is feasible to do so, and no reference of record provides the necessary connection between optical bubble detection and the use of optics to predict imminent failure of a gas sensor.

<sup>Krasberg?</sup>  
(Gates) arguably indicates that bubble formation is undesirable in certain electrochemical cells, but provides no suggestion or reason to monitor for the formation of gas pockets. Further, Gates and Japan 59-54936 are not properly cited because are non-analogous art because they do not pertain to the general technological field of electrochemical cells, but to leak detection in submerged, pressurized containers. Gates and Japan 59-54936 do not even detect collection of gas in a pocket prior to failure of the usefulness of whatever device to which they apply, they only detect bubbles. Lastly, bubble detection in Gates and Japan 59-54936 is achieved by light scattering (reflection), not primarily by refraction, as in the present invention. For these reasons, Applicants believe that the use of optical methods to detect collection of gas in an electrochemical cell, to anticipate failure of the cell, is not obvious over Krasberg in view of Gates or Japan 59-54936.

Claims 5-12, 18-25 and 32-41 are rejected under 35 U.S.C. §112, second paragraph for indefiniteness. In response, Applicants have amended the claims for clarity. As stated above, all functional language is believed removed to the extent possible, and the metes and bounds of the claims would be readily apparent to a person of ordinary skill in the art. MPEP Section 2173.05(g) ("Functional Limitations") recites:

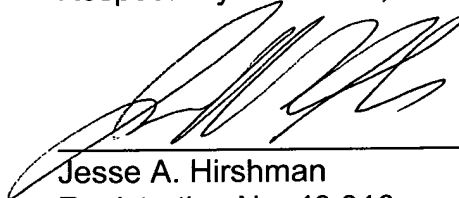
a functional limitation is an attempt to define something by what it does, rather than by what it is (e.g., as evidenced by its specific structure or specific ingredients). There is nothing inherently wrong with defining some part of an invention in functional terms. Functional language does not, in and of itself, render a claim improper. ... A functional limitation must be evaluated and considered, just like any other limitation of the claim, for what it fairly conveys to a person of ordinary skill in the pertinent art in the context in which it is used. A functional limitation is often used in association with an element, ingredient, or step of a process to define a particular capability or purpose that is served by the recited element, ingredient or step.

On the top of page 8 of the Action, the Examiner retorts: "[s]urely, applicant does not regard a bracket or brackets per se to be inventive." In response, if a bracket is novel and non-obvious, it is patentable. The bracket or combination of brackets claimed in original claim 33 is novel and non-obvious absent art indicating that such a bracket or combination of brackets exists in the prior art or is obvious in view of that art.

Applicants' use of "functional language" is not preferred, but, as mentioned above, functional language does not, in and of itself, render a claim improper. Further, a person of ordinary skill in the art would know exactly what the apparatus would comprise from reading the plain language of the claims. Applicants have rewritten "bracket" claim 33 as claim 71 and also have included claim 65, which claims a kit containing the bracket or set of brackets, a light source and a light detector in addition to the bracket. In view of the above, Applicants respectfully request reconsideration of the rejection of claim 33, now claims 65 *et seq.* and 71.

Applicants believe that new claims 42-71 define over the prior art of record and are in proper form for allowance. Applicants respectfully request allowance of claims 42-71.

Respectfully submitted,



Jesse A. Hirshman  
Registration No. 40,016

Attorney for Applicants

KIRKPATRICK & LOCKHART LLP  
Henry W. Oliver Building  
535 Smithfield Street  
Pittsburgh, Pennsylvania 15222-2312  
Telephone: (412) 355-8966  
Facsimile: (412) 355-6501  
E-mail: [jhirshman@kl.com](mailto:jhirshman@kl.com)